EyeLink® Video Overlay Option User's Manual

(Tracker version: 2.0)

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1. Introduction

The EyeLink II video overlay system uses the EyeLink II tracker to generate real-time overlay graphics, which are superimposed on a video source, and the composite output is typically recorded by a VCR or DVD recorder. The video source is typically a Windows computer display (using a VGA-to-video converter, tested), or a stationary scene camera. A video overlay for calibration of other sources (camera or VCR) displayed to the subject on a video monitor can also be generated (requires manual video switching at present). This option is often used to provide a gaze overlay onto a dynamic stimulus display, like a web browser, AVI file, or DVD movie. The EyeLink II Video Overlay is an additional option for the EyeLink II which can be purchased with the base EyeLink II system, or at a later date.

2. System Requirements and Configuration

This is a Hardware Installation guide section and should only be followed if you have not changed any of the scan converters memory settings. The following notes assume that a Windows PC is being used as a video source, and that Composite Video is used throughout. A VCR is not mentioned.

Before you start, please check that the following items are included in the EyeLink overlay option package:

- A VGA-to-video converter (CORIOscan Select; see Figure 1) for the Windows display that will produce the subject display. This converter has both S-Video (also called Y/C) and Composite Video output. This converter requires a DC 12V, 800 mA power supply (the "TVOne" AC Adaptor).
- A VGA overlay device for video (AVT-3170 Scan Converter; see Figure 2). This converter accepts both S-Video and Composite Video input. This converter requires a DC 6V, 1000 mA power supply (the "Ever Glow" AC Adaptor).
- Two VGA cables, one for each of the display and host PCs video conversion.
- Several S-Video or composite video cables — buy longer cables for future flexibility.

For the purpose of demonstration, the user should have a good monitor with S-Video or composite video inputs ready, for use in analysis and setup. Small monitors may be obtained from professional video suppliers, or a larger high-end TV/monitor may be used.

2.1 Wiring

Connect the CORIOscan Select converter box to the Display PC (see Figure 1):

1) Attach the supplied VGA cable between the "PC In" connection and the VGA card in the computer.
2) Connect the "PC Out" to the monitor of the Display PC.
3) Plug in the 12V "TVOne" power adapter.

Figure 1. The CORIOscan Select Converter for the Display PC

Similarly, connect the AVT-3170 Scan Converter to the Host PC (see Figure 2):

1) Attach the supplied VGA cable between the “VGA In” connection and the VGA card in the computer.

2) Connect the “VGA Out” to the monitor of the Host PC.

3) Plug in the 6V “Ever Glow” power adapter.

Make the connection between the display (CORIOscan Select) converter and the host overlay box (AVT-3170 Scan):

1) Have the “Composite Video: Out 1” of the display converter connected to the “V-IN” of the host overlay box with a composite video cable (illustrated in Figures 1 and 2). If, however, a S-Video cable is used, make the connection between “S-Video: Out 1” of the display converter and “S-IN” of the host overlay box.

2) Set the Video Input as “V-IN” if a composite video cable is used in the above step (illustrated in Figure 2) or “S-IN” if a S-Video cable is used.

3) For best overlay quality, set the Overlay (Key) switch to “BLACK”. Set TV System to “NTSC” in North America and “PAL” in Europe.

Figure 2. The AVT-3170 Scan Converter for the Host PC

Finally, connect the "S-Out" of the overlay box to an S-Video input on your monitor or TV (illustrated in Figure 2). If a composite video cable is used, connect the "V-OUT" to Composite input. If a VCR is used, it would be connected between the overlay box and the monitor.

2.2 Software Installation

Copy the existing EyeLink2 directory on the host PC to a new folder as a backup. Then copy the supplied files into the "eyeLink2\exe" directory. These should overwrite the eyelink2.ini and the eyelink2.exe files, and add a number of extra files (vidovl.ini and final.ini). The vidovl.ini file contains all of the settings for using the video overlay option. You may also need to check for the settings in the physical.ini file to make sure that the display monitor physical dimensions and display PC gaze coordinates are properly set. If changes to these default settings are required, please cut and paste the commands to the final.ini and make the modification in that file for the ease of future maintenance. Please also make sure that you have either track.exe or cal_popup.exe installed on your display PC to perform calibration, validation, and drift correction.

3. Setting up the EyeLink Video Overlay

Performing the following steps are important for getting a precise alignment of the source video from the display PC and the gaze position from the Host PC. If the settings have been properly saved, this needs to be done only once. However, it is a good practice to check the settings again at the beginning of each recording session to make sure that alignment of video sources is still ok.

3.1 Setting up the Video Source (Display PC)

Performing this setup is essential to create a blank (usually black) border around the Windows desktop image. This prevents overscan (clipping of edges of the image) when displaying recorded sessions on TVs, and also allows a blank area for the gaze cursor to be visible when outside the desktop, and for the timecode display.

IMPORTANT NOTE: Be sure to do the setup with the same monitor you will be viewing the video with, as monitors and TVs vary in how much of the edges of the video can be displayed. If you plan to show the recorded video on ordinary TVs (at conferences, for example), then use this type of display for setup, or you may not be able to see the edges of the Windows desktop. Otherwise, use a professional monitor to maximize use of the video image.

1) Turn on the display PC. Configure the Windows display for the resolution and refresh rate you will be using (1024x768 or lower).

2) The next step is to display the source video on the TV monitor. Click on the "MODE" button of the Host AVT-3170 Scan converter to set the mode to "Video" (Check the green light indication on the front of the converter box). This will only show the source video from the Display PC on the TV monitor.

3) The AutoSet function of the CORIOscan Converter needs to be run to correctly display the image from the computer. Press "Autoset" (Button A, Figure 3) on the CORIOscan remote control to preset the video parameters. The image on the TV will now begin to move around the screen. Once this has stopped, the AutoSet function is complete.

4) Press the "O.Scan" (Button D, Figure 3) on the remote (or the middle button of the converter box, Button 2, Figure 4) to make the image smaller.

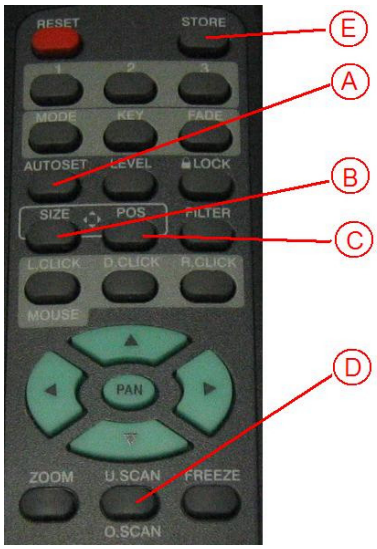

Figure 3. Some Important Buttons on the CORIOscan Remote Control

5) Take a look at the image of the source video on the TV monitor. If the image does not have a substantial black border all around it on your display (including some black at the corners), you will need to adjust the size of the image.

   a. You can use the remote control to set the image size:

   - Press the "Pos" button (Button C, Figure 3), then use the arrow buttons to center the image (if the arrow keys don't work, press the "Pos" button again).

   - Press the "Size" button (Button B, Figure 3), then use the arrow buttons to adjust the size of the image (if the arrow keys don't work, press the "Size" button again).

   - Press the "Store" button (Button E, Figure 3) to save these settings. You should hear two beeps when the settings are saved.

   a. You can also use the manual menu buttons on the CORIOscan converter to do this adjustment. To manually set the source video size with the CORIOscan menu:

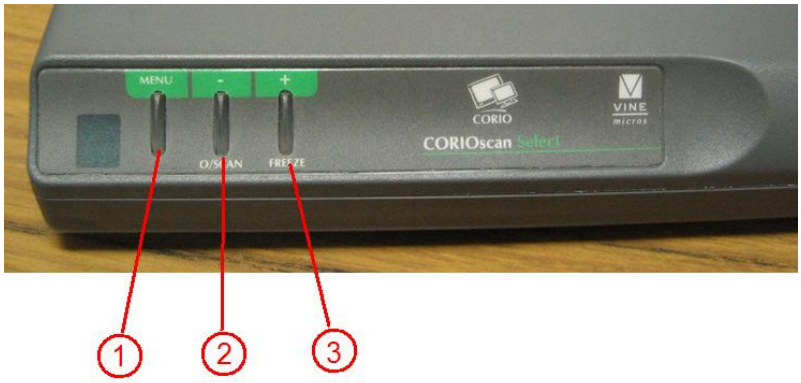

Figure 4. Buttons on the CORIOscan Select Converter Box

- Press Button 1 (MENU) until "Screen Size" appears, then press Button 3 to select the "Out H-Centre" menu. Use Buttons 2 (-) and 3 (+) to center the image.
- Press Button 1 to switch to the "Out H-Width" menu, then use Buttons 2 and 3 to set the display width.
- Press Button 1 to switch to the "Out V-Centre" menu. Use Buttons 2 and 3 to center the image.
- Press Button 1 to switch to the "Out V-Height" menu, then use Buttons 2 and 3 to set the display height.
- Continue this process (press the Button 1 to select an adjustment, then use the Buttons 2 and 3) until the desktop is centered and has a blank border of the proper size on your display.
- Press the "Store" button on the remote control (Button E) to save these settings. You should hear two beeps when the settings are saved.

3.2 Setting up the Host Video and Calibrating Overlay Display

Calibrating the overlay graphics display to an external video source and overlay device are very simple to do, once the overlay device has been configured to use part of the EyeLink display. A video source with a visible region (typically video of a Windows desktop) corresponding to the gaze coordinate system defined with the configuration command "screen_pixel_coords" is displayed on a video monitor, in combination with graphics from the EyeLink display. A box consisting of a highly visible moving pattern is then adjusted in size and position to match this region. After this is done, the overlay is ready to use. This setting needs to be done only once, unless the source video scaling or overlay device settings are changed.

1) Start the host PC, if you haven't done that. With the Overlay Box remote, press the "MODE" button until the green light indication on the front of the converter box is at "OVERLAY".

2) Start the EyeLink program (eyelink2.exe). The EyeLink video overlay option is enabled and disabled from the Set Options screen. Two buttons have been added: an "Enable Overlay" toggle button (press the 'O' key as a shortcut), and a "Video Setup" button (press the 'W' key as a shortcut) that switches to the Video Setup screen. These buttons are only available on EyeLink systems configured for video overlay support.

3) Go to the Video Setup screen. Press button 5 of the overlay remote control to set the overlay box to 2X zoom. On the Host display, note the drawing of a box with arrows (see Figure 5), located just inside the top-left or bottom-right corner of the calibration box. This corner of the box may be moved with the arrow keys of the host keyboard (the mouse is not used because of the high precision required).

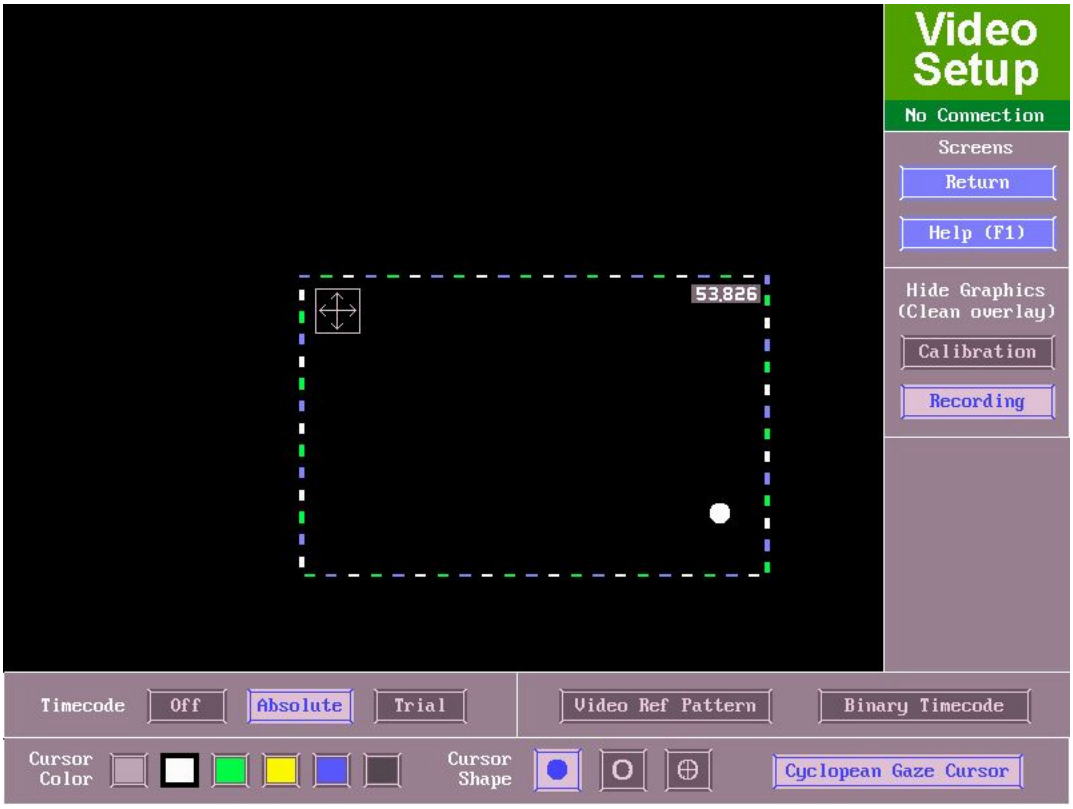

Figure 5. The Video Setup Screen

- While viewing the video display on the TV monitor, adjust the box so that the outside of the moving pattern of the calibration box is on or just inside the desired area of the video (see Figure 6).

Figure 6. Calibrating the Overlay Display Size

- Once one corner is adjusted, switch to adjusting the other corner by pressing the "Tab" key. You can return to the top-left by pressing Tab again, if needed.

- The box can quickly be reset to the size of the dark gray default area by pressing the "F9" key.

Note: The overlay display adjustment needs to be done only once as long as the overlay settings haven't been changed. However, at the beginning of each recording session, the user needs to press button 5 of the overlay remote control to set the overlay box to 2X zoom. This ensures the video source of the Display PC and EyeLink display stay properly aligned.

3.3 Configuring the EyeLink Video Overlay

When video overlay is enabled, the gaze display window of the Offline, Calibration, Validation, Drift Correction, Output, and Recording screens have a black central window in the area where the video overlay is generated, with the remainder of the window filled with dark gray. The overlay background can also be set to gray (or any other color) on the Calibration, Validation, and Drift Correction displays to hide source video—this enables the EyeLink to produce calibration targets for display on a video monitor.

Gaze cursors are reduced in size and have a selectable shape and color when only one eye is being tracked. User-drawn graphics behind the gaze cursor may be suppressed if desired to preserve a clean overlay, or added to the video overlay

as desired. Finally, a timecode may be placed anywhere in the overlay area, displaying the time from the start of the trial (either from start of recording or from the last "SYNCTIME" message placed in the EDF file), or the tracker timestamps that are being placed in the EDF file and sent with real-time link data. The following sections details the functions that may be performed and options set with the Video Setup screen.

3.3.1 Selecting the Gaze Cursor Appearance

Gaze cursors for use in the video overlay have a selectable shape and color to improve visibility (see Figure 7). Gaze cursors may either be a solid circle, a hollow circle, or a hollow circle with a central cross. Select a cursor shape by clicking on the appropriate button at the bottom of the Video Setup screen.

In a binocular recording, if the "Cyclopean Gaze Cursor" button is enabled, the tracker will draw a single (cyclopean) gaze cursor, representing the average of the two eyes. Several colors can be selected for a cyclopean or a monocular gaze cursor, the most useful of which are yellow and white. This color can be selected in the same way as cursor shape (the currently selected color is indicated by a solid black border). If that "Cyclopean Gaze Cursor" button is disabled, gaze cursors are drawn separately for each eye – blue and yellow for the left eye and right eye respectively (see the settings in the vidovl.ini configuration file).

Figure 7. Selecting the Gaze Cursor Appearance.

3.3.2 Setting the Timecode Display

The timecode display is enabled by selecting a timecode mode option (see Figure 8) using the buttons at the bottom of the screen (use the "T" key to step through options). The timecode display may then be positioned by dragging it with the mouse cursor to its new position. It may be possible to place the timecode display above or below the video, if a blank area has been left as recommended.

Figure 8. Setting the Timecode Display

The timecode may be set to "Absolute", which displays the actual tracker time in milliseconds that is used for the timestamps of samples, events, and messages recorded in the EDF file or as real-time link data. This may be used to match times to a raw ASC file, for example. If the "Trial" mode is selected, the timecode displays the milliseconds elapsed since the start of the trial. This is defined either as the start of recording, or as the time of the last "SYNCTIME" message

placed in the EDF file. This message may also include a time offset, placed before or after the "SYNCTIME" keyword, indicating the delay in milliseconds from the start of trial to when the message was actually sent.

A symbol at the left side of the timecode display indicates the timecode mode. A small "T" at the top indicated "Trial" mode with time elapsed since the start of recording. If a "SYNCTIME" message has been received, a "U" at the bottom indicates that a user-defined start time is being used. No symbol indicates that "Absolute" timecode mode is active (illustrated in Figures 5 and 6).

The timecode is displayed as up to 9 digits (8 digits in "Trial" mode), with a decimal point indicating the transition between seconds and milliseconds. It is unlikely that the last digit of the milliseconds will be useful, however, because of the timing of video displays and the nature of most overlay devices.

3.3.3 Graphics Options

In some cases, calibration graphics need to be presented on the video display. These graphics can be generated by the EyeLink overlay, when the "Calibration" button is selected (see Figure 9). For this purpose, the overlay background on the Calibration, Validation, and Drift Correction displays is set to gray (or any other color specified in the vidovl.ini file) to hide source video. In addition, all feedback graphics are suppressed within the calibration display until the end of calibration, to eliminate distractions.

Figure 9. Graphics Options

User-drawn graphics can be displayed behind the gaze cursor during recording. These graphics are also useful in video overlays and may aid analysis or serve illustrative purposes. However, some experiments may create bright or distracting graphics that will block the source video. The "Recording" button can be selected to block the display of these graphics, and to preserve a clean overlay.

4. Using the EyeLink Video Overlay

The current section outlines data recording with the EyeLink Video Overlay option, assuming that you have completed the wiring and configuration discussed in the previous sections. If the EyeLink software is not yet running on the host PC, start it by typing

```
CD C:\EYELINK2\EXE ↵
EYELINK2 ↵
```

Once the program starts up, press button 5 of the overlay remote control to set the overlay box to 2X zoom. Go to the Video Setup Screen to check that the Display PC source video and the EyeLink Host overlay graphics stay properly aligned. Now start the "popup calibration" utility on the Display PC by selecting

Start->Programs -> SR Research EyeLink -> Utilities -> Popup Calibration

4.1 Camera Setup

The popup calibration utility can be used to perform camera setup, calibration, validation, and drift correction. When the program starts, first enter the name of the EDF file in the "Create EDF File" dialog (Note: This utility was programmed such that you can easily switch to your own experiment tasks, it is likely that when you entered your file name, the application will be minimized. Click on the blue "eye" icon on the Windows task bar to maximize the application again). Go the Camera setup screen and press the "ENTER" key on the host PC keyboard to transfer the camera image to the display PC. Set up an experiment volunteer and perform camera setup, calibration, and validation as usual (read the EyeLink II User Manual version 2.0 if you need more information).

4.2 Pre-recording Preparations

Now you can switch to your own experiment task and start recording by pressing the 'O' key on the host PC. If the popup calibration utility is still connected to the tracker, an EDF file is already opened for data recording; otherwise you will need to open a recording file on the Output Screen by clicking on the "Open File" button, entering the file name and then pressing the ENTER key (see Figure 10). In either case, the user can add custom messages to the EDF file by clicking on the "Add Message" (not shown in the example). Press the "Record" button to start recording.

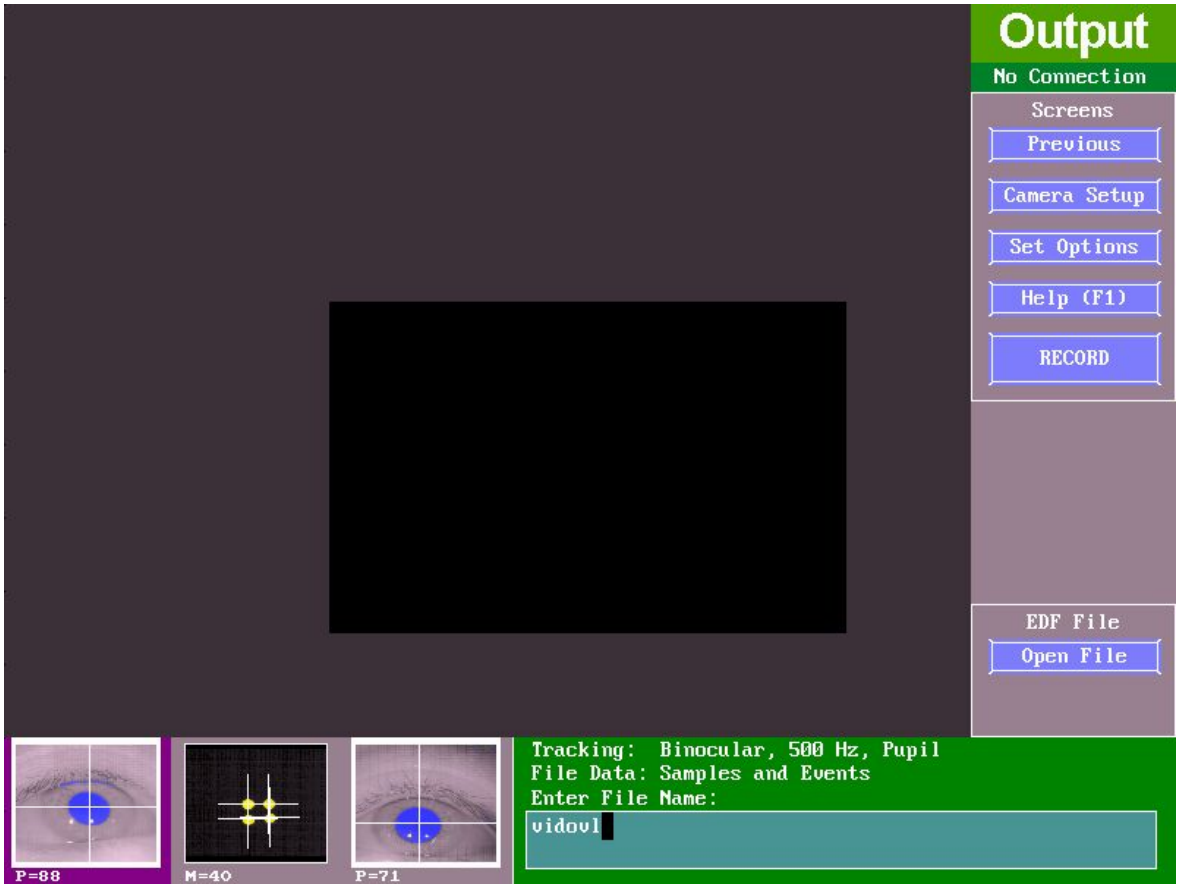

Figure 10. Opening an EDF file for Data Recording

4.3 Recording and Drift Correction

During recording, the TV monitor will show the gaze cursor overlaid on the source video shown to the subject. If the experimenter notices excessive drifts in the gaze cursor drawing, a runtime drift correction can be performed if your paradigm permits. There are two ways of performing an online drift correction during recording:

1) If it is very likely that the subject will look at a particular point across trials, a reference position for drift correction could be defined at that position. This can be done by editing the value of "`online_dcorr_refposn`" in the calibr.ini or final.ini file under c:\eyelink2\exe directory of the host PC. When the subject is looking at the reference position, pressing 'F9' key on the host PC will perform the drift correction.

2) Alternative, an online drift correction can be performed with the aid of a mouse click. Before recording, add the following line to the final.ini file:

    video_click_dcorr = ON

This will bring up an additional clickable drift correction button in the record screen. Click on the "Drift Corr" button, which will flash periodically if enabled. Move the mouse cursor over the intended drift correction target and instruct the participant to fixate the target precisely. Press the button only once when the participant fixates stably. The drift correction may fail if there is no stable fixation data or if there is a large error between the current fixation and the target item. By default, the maximum acceptable error value (set by the `'online_dcorr_maxangle'` command) is 5.0°.

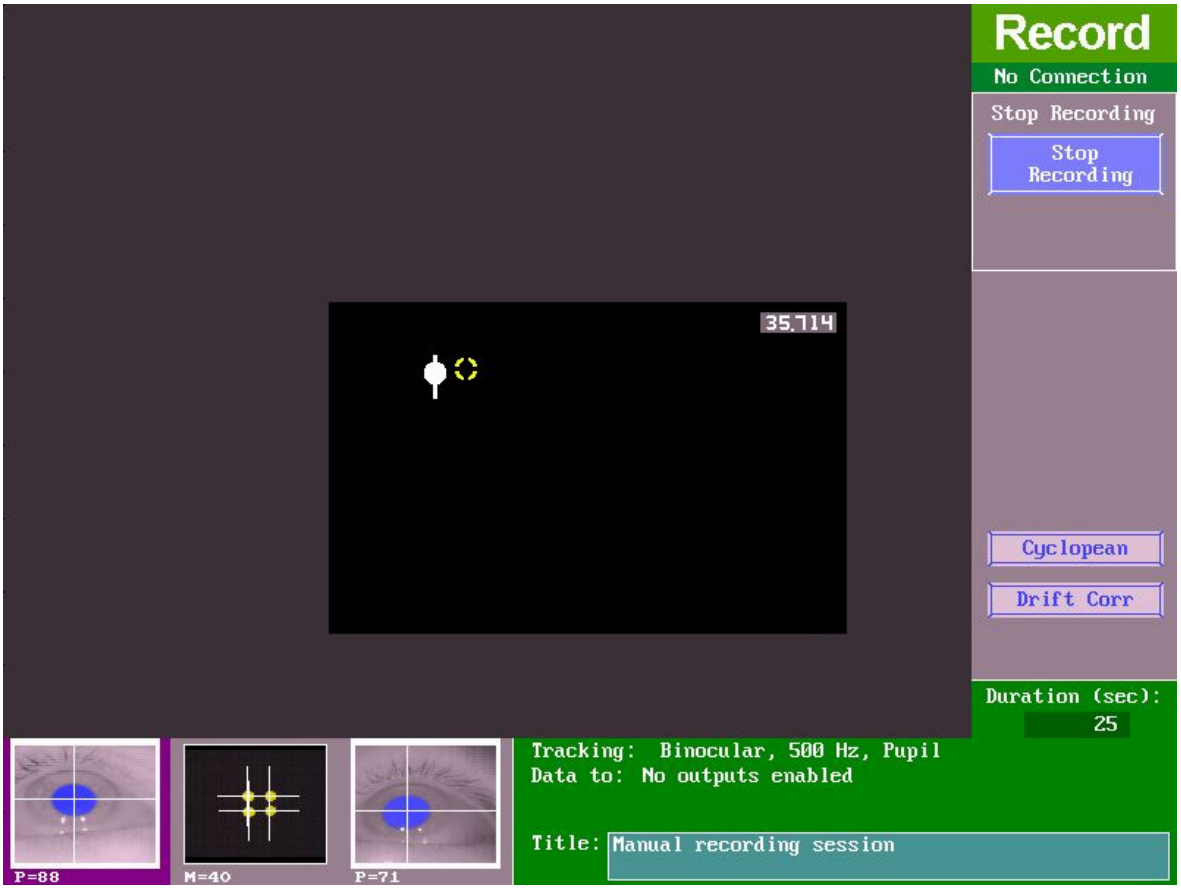

Figure 11. Performing an online drift correction with mouse click

If the popup calibration utility is still connected to the tracker, a drift correction can also be performed outside of a recording trial. First set the tracker to the Camera Setup screen and press 'D' to start drift correction – you may also need to click on the blue "eye" icon on the Windows task bar on the display PC to maximize the popup calibration application again so that the drift correction target is visible to the participant. If the data quality is not improved following the drift correction, the experimenter should check the camera setup and redo calibration, and validation.

4.4 Stopping Recording and Data Transfer

After the experiment ends, the user can stop recording of eye data. The EDF file can be closed by pressing the "Close File" button in the Output Screen (see Figure 12). The EDF file can be transferred to the display PC by using the "GetFile" utility (Start->Programs -> SR Research EyeLink -> Utilities -> GetFile).

Figure 12. Closing an EDF file.

5. Technical Issues

Although the EyeLink display continually updates the latest gaze cursor position and time, the graphics are only transferred to the overlay device at the refresh rate of the video card (typically 60 or 72 Hz, or every 16.7 or 13.9 milliseconds). Most commercially available overlay devices use “anti-flicker” techniques, that occasionally average 2 overlay images together before applying the collected image to the video. This means that some digits of the timecode may be seen as a superposition of one or more digits. The first, and usually the second, digits of the timecode can be read, which is sufficient to match to times in a recorded data file.

In addition, this averaging of multiple overlay images means that a moving gaze cursor may be seen as multiple darker images. This is never a problem during fixations, and video records of eye movements are never analyzed for saccadic parameters in any case.

6. EyeLink Commands For Overlay Configuration

These commands may be sent by the **`eyecmd_printf()`** function to the EyeLink tracker, or included in the vidovl.ini file. Some are overridden by the lastrun.ini file, which is written after each session.

6.1 Video Overlay Enable

6.1.1 video_overlay_available

`video_overlay_available = <YES or NO>`

Sets whether EyeLink is configured for video overlay—in particular, NO hides the Video Overlay buttons in the Set Options screen. If not set, this defaults to NO, so the vidovl.ini file can be excluded from the distribution.

Arguments: YES to enable video overlay in the Set Options screen
NO to disable video overlay

6.1.2 video_overlay_on

`video_overlay_on = <OFF or ON>`

Sets the state of the video overlay mode. This is updated at the end of each session to the lastrun.ini file, which overrides the vidovl.ini file.

Arguments: OFF if video overlay mode is off
ON if video overlay mode is active

6.2 Video Overlay Colors

6.2.1 video_background_color

`video_background_color = <palette index>`

Sets the background color for overlay—this is always black (128).

Arguments: palette index (always black = 128)

6.2.2 video_border_color

`video_border_color = <palette index>`

Sets the dark gray used for the area of the gaze window outside the active overlay area, and for the gray box on the Video Setup screen. This color should be visibly different from black, but below the default keying level. A palette index of 136 is standard.

Arguments: palette index (dark gray = 136)

6.3 Overlay Gaze Cursors

6.3.1 video_monoc_cursor_color

`video_monoc_cursor_color = <palette index>`

Sets the color of the monocular overlay gaze cursor. If this is not one of the preset options in the Video Setup screen, it will replace the first entry (light gray) in the color choices. This is updated at the end of each session to the lastrun.ini file, which overrides the vidovl.ini file.

Arguments: Palette index.

6.3.2 video_binoc_cursor_colors

`video_binoc_cursor_colors = <l>,<r>,<c>`

Sets the colors of the binocular gaze cursors. The 3 colors are the left cursor, right cursors, and any overlap between them.

Arguments: <l>: palette index of left cursor (typically 214)
<r>: palette index of right cursor (typically 234)
<c>: palette index of overlap between left and right cursors (typically 180)

6.3.3 video_cursor_type

`video_cursor_type = <shape number>`

Sets gaze cursor shape. Choices are 0 (solid) or 1 (hollow). This is updated at the end of each session to the lastrun.ini file, which overrides the vidovl.ini file.

Arguments: <shape number>: 0 for filled, 1 for hollow circle

6.3.4 video_cursor_limit

`video_cursor_limit = <pixels>`

Sets how far the gaze cursor is allowed to move outside the standard gaze area (set by "screen_pixel_coords"). For the vide overlay, we want part of the gaze cursor to stay in this area, and thus be visible, so this value should be ½ the cursor diameter, or 8 pixels.

Arguments: <pixels>: limit on motion.

6.3.5 video_dim_mouse_fgcolor

`video_dim_mouse_fgcolor = <palette index>`

Sets the color for the "dimmed" mouse pointer allowed inside the active overlay area. Typically 140, or slightly brighter that the borfer gray.

Arguments: <palette index>: 140

6.3.6 video_dim_mouse_bgcolor

`video_dim_mouse_bgcolor = <palette index>`

Sets the color for the "dimmed" mouse pointer allowed inside the active overlay area. Typically 128, or black.

Arguments: <palette index>: 128

6.4 Special Display Modes

6.4.1 video_no_record_graphics

`video_no_record_graphics = <ON or OFF>`

Whether the display of user background graphics is suppressed in Record mode. This is updated at the end of each session to the lastrun.ini file, which overrides the vidovl.ini file.

Arguments: <ON or OFF>

6.4.2 video_cal_hide_cursors

`video_cal_hide_cursors = <ON or OFF>`

Whether the special video calibration generation option is enabled. This will hide cursors and feedback graphics, and use a lighter background. This is updated at the end of each session to the lastrun.ini file, which overrides the vidovl.ini file.

Arguments: <ON or OFF>

6.4.3 video_cal_target_size

`video_cal_target_size = <size>`

Sets size of calibration targets in video overlay mode. Legal values are 7, 9, 11, or 13 pixels (13 is the regular calibration target size). Smaller sizes are useful when the calibration display is used as a video overlay, to compensate for the magnification of the overlay.

Arguments: <size>: 7, 9, 11, or 13 pixels (9 default).

6.4.4 video_cal_backgr_color

`video_cal_backgr_color = <palette undex>`

Color of calibration background when the calibration overlay option is enabled (black in normal mode). Default is 156 (medium gray).

Arguments: <palette index>: typically 156.

6.4.5 video_cal_target_color

`video_cal_target_color = <palette undex>`

Color of calibration targets when the calibration overlay option is enabled (black in normal mode). Default is 127 (bright white).

Arguments: <palette index>: typically 127.

6.5 Timecode Settings

6.5.1 video_timecode_mode

`video_timecode_mode = <mode>`

Sets the timecode mode. This is updated at the end of each session to the lastrun.ini file, which overrides the vidovl.ini file.

Arguments: <mode>: 0 is off, 1 is absolute, 2 is trial

6.5.2 video_timecode_position

`video_timecode_position = <x>, <y>`

Sets position of top-left of timecode display. This is updated at the end of each session to the lastrun.ini file, which overrides the vidovl.ini file.

Arguments: <x>, <y>: pixel coordianted of top-left

6.5.3 video_timecode_bgcolor

`video_timecode_bgcolor = <palette index>`

Color of timecode background. Default is 150 (gray just brighter than overlay key).

Arguments: <palette index>: typically 150.

6.5.4 video_timecode_fgcolor

`video_timecode_fgcolor = <palette index>`

Color of timecode numbers. Default is 127 (bright white).

Arguments: <palette index>: typically 127.

6.6 Video Overlay Window

6.6.1 video_window_default

`video_window_default = <l>,<t>,<r>,<b>`

Sets the large dark gray box on the Video Setup display ised for overlay setup. Also is the ocerlay window size set by pressing the F9 key..

Arguments: Typically 205, 23, 586, 351 for smaller "2x zoom" overlay area.
Typically 116, 35, 560, 360 for large overlay area.

6.6.2 video_window

`video_window = <l>,<t>,<r>,<b>`

Sets the overlay window size and position. This is updated at the end of each session to the lastrun.ini file, which overrides the vidovl.ini file.

Arguments: <l>,<t>,<r>,<b>: box coords